Activity II: Travel and the Spread of Disease

Travel has been linked to the spread of disease for centuries. With the increased development of transportation, including highways and airports, the road is being paved for the speedy transport of diseases from one place to another.

You will be assigned one epidemic to research as a group, using the prompts and questions below. Use the following websites to answer these questions and begin your group work.

Thinkquest (**Start here**!): http://library.thinkquest.org/11170/
CDC: http://www.cdc.gov/
CDC Traveler's Health: http://www.cdc.gov/travel/
(check out "destinations" and "diseases")
National Center for Infectious Diseases: http://www.cdc.gov/ncidod
Pan American Health Organization: http://www.paho.org/
World Health Organization: http://www.who.org
Division of Global Migration and Quarantine:
http://www.cdc.gov/ncidod/dq/index.html (for list of Communicable Diseases of current concern)
FluNet for data after 1999: http://oms2.b3e.jussieu.fr/flunet/activity.html
20 Years of AIDS Research at NIH "In Their Own Words":
http://www.niaid.nih.gov

Also consider online resources from medical journals such as the Emerging Infectious Diseases Journal at http://www.cdc.gov/ncidod/eid/index.htm. The following articles are a nice start:

Dr. Mary E. Wilson's "Travel and Emergence of Infectious Diseases" from April-June 1995: http:///www.cdc.gov/ncidod/eid/vol1no2/wilson.htm

Dr Stephen S. Morse's "Factors In the Emergence of Infectious Diseases" at http:///www.cdc.gov/ncidod/eid/vol1no1/morse.htm

Pim Martens and Lisbeth Hall's "Malaria on the Move: Human Population Movement and Malaria Transmission":
http:///www.cdc.gov/ncidod/eid/vol6no2/martens.htm

Activity II: Travel and the Spread of Disease

1. What are the four ways in which epidemics are spread? After listing each, provide one example of a situation where transmission could occur. *(Be sure your examples are appropriate!)*

   1. _____

   example: _____

   2. _____

   example: _____

   3. _____

   example: _____

   4. _____

   example: _____

2. What are the three kinds of epidemics listed?

   a)

   b)

   c)

   Bonus: What is the fourth?

   d)

3. Group Work: Your teacher will assign you one of the following epidemics.

   Mad Cow-related human diseases
   Ebola
   AIDS
   Black Death and Bubonic Plague
   Smallpox
   Typhoid
   Influenza

Activity II: Travel and the Spread of Disease

Research this epidemic using the web sites listed or other information. Also answer the questions below. You will be giving a ten minute presentation on your epidemic, so be prepared to present your information in a polished form.

a) How could your epidemic be spread through travel (on airplanes or ships)? Describe each situation completely in a paragraph. Your situations should be appropriate for the mode of travel and should be feasible as likely situations.

b) Did any of these situations occur? Use a map and/or historical account to determine if spread of the epidemic can be accounted for, in part, due to ship or airplane travel.

c) What are general details about the disease? List:

- basic symptoms
- required gestation times
- where it originated
- what it does to its host

d) What was the speed of spread of one of the epidemics?

- Create a timeline to show the sequence of number of victims (and location, if this is available) by this epidemic.
- Find the number of cases per year over the period of time that is documented for this epidemic and plot them on a scatterplot (use a seperate sheet of paper).

e) Indicate the following in a chart covering up to 30 years.

- Number of cases/victims

- # Victims this year - # victims last year.
  Answers will be positive or negative, depending on growth or decreases.

- % change (positive or negative)
  Plot percent change versus time on a new graph for your epidemic over this time (up to 30 years).

f) When were effective treatments imposed or sanitation / preventative measures imposed? Can you identify main factors contributing to the demise of the epidemic? Mark these on your graph.

4. Share your information with the class in a 10-minute multimedia presentation. Include plenty of visuals including your charts and graphs.

Activity II: Travel and the Spread of Disease

5. As a class, compare graphs, charts, the aviation timeline, and the passenger miles chart to help you answer the following questions.

Aviation Timeline :

1903: Wright Brothers' "Flyer" makes first controlled flight of a powered, heavier-than-air aircraft.

1909: Monoplanes developed and used for relatively short-distance flights.

1911: First practical seaplane built.

1913: Airplanes used by French and British during WW1 as bombers and surveillance craft.

1918: Fighter planes developed (and used in battle).

1927: Long-distance passenger craft developed that had constant radio contact with the ground.

1930s: The "Air Age" begins with pioneers like Amelia Earhart, Howard Hughes, and Charles Lindbergh.

1933: First of the modern airliners (Boeing 247) developed. It could carry 13 passengers and travel at 155 mph.

1936: Spitfires (fast maneuverable fighter airplanes) developed for use in WWII.

1943: Helicopters are mass-produced for WWII.

1943: Jet-powered fighters are developed and used in WWII.

1947: Airplanes fly faster than the speed of sound.

1947: Radar is developed to keep track of aircraft from the ground.

1950s: The airliner begins to replace other means of transportation as the primary means of long-distance travel.

1968: Aircraft are developed that can take off and land vertically, without the use of a runway (Harrier "Jump Jet.").

1969: The Concorde is developed and used as the first supersonic airliner. (It crosses the Atlantic Ocean in less than 3 hours.)

1981: Space Shuttle is developed as a reusable space ship that can land after reentry into Earth's atmosphere.

1981: The Lockhead F-117A is developed, which is virtually invisible to radar.

Activity II: Travel and the Spread of Disease

Passenger Miles for US Intercity Air Traffic

Year	Miles (billions)
1945	3
1950	10
1955	23
1960	32
1965	54
1970	109
1975	136
1976	150
1978	189
1979	210
1980	204
1981	201
1982	214
1983	232
1985	263
1986	293
1987	322

Note: This does not apply to international travel.

Activity II: Travel and the Spread of Disease

5a) Is spread of epidemics linked to increased air travel?

- Defend your answer.
- Determine statistically.
- Provide examples of epidemics that are directly linked to air travel.

b) How might air travel change to restrict epidemic spread, if it is to be held accountable for it? Are there things done now, that you know of?

c) We have not considered some important characteristics of epidemics, when accounting for number of cases in a year. For instance, AIDS and Influenza are very different, and some researchers say they should not be evaluated in the same way. Why not? What can we include in our analysis to account for this?

d) Design a model to further research the influence of air travel on the spread of epidemics. Your test must follow these restrictions:

- It must be of a small-scale, as it will be modeled in a classroom.
- It must be harmless.
- It must be easy to measure.
- One must be able to do it in less than one hour.

e) Bonus Question (Extra Credit): Why did passenger miles decrease in 1980 and 1981?

6. Handshaking has been known to be linked to the spread of illness.

The number "N" of possible handshakes within a group of "n" people is approximated by the polynomial $N = (1/2)n^2 - (1/2)n$

a) Compare the number of handshakes

- at a political rally (n = 500)

- at an investment banking meeting (n = 50),

- or a business department meeting (n = 10).

b) In the United States, the amount of colds you catch can be approximated as $(1/100)((1/2)n^2 - (1/2)n)$. In Finland, the amount of colds can be approximated as $(1/200)((1/2)n^2 - (1/2)n)$. In which country was there a lot of advertisement about the benefits of washing your hands? Prove this by showing the respective number of cold-exposure in a room of 100 people in Finland or the United States.

c) Of course, being exposed to a cold does not mean you will "get" the cold. What can people do to help prevent common illness (like Influenza, colds, and infections) in their every day lives, without the help of a doctor?

7. Discussion of the perpetuance of illness:

a) People can be immunized for many kinds of diseases. Similarly, there are treatments available for many diseases. If you are treated for an illness, why might you still get sick?

b) Why does the journal "Nature" tell readers to be cautious in believing people that say we have nothing to worry about regarding epidemic strains in chickens, pigs, or cows?

c) There are Mad Cow -Related Diseases in cows, cats, sheep, and humans. Create a tree of relatedness that shows these 4 groups and how they are related.

d) Where would the following be on your tree (draw them in)? Mouse, Salmon, Snail, Finch, Python, Alligator

e) Obtain sequences of DNA, RNA, or protein that are related to an illness that apparently spans across several animal groups (at least 4 groups is ideal).

i) The keywords for my search will be prion, scrapie, mad-cow disease, Creutzfeldt-Jakob disease (CJD), sheep, cow, cat, human and (circle one) nucleotide / protein.

ii) Fill in the chart below. Ideally, all of your sequences will be from **different organisms** BUT will be of **similar types** (for instance, all DNA), **size** (for instance, all about 795 base pairs), and have **similar significance** (for instance, all are sequence for WW gene and all are related to SS disease).

Note: Often researchers will list sequences that are related to each other in their notes. Pay special attention to this, as it will help you determine what other sequences to look for.

LOCUS #	Organism	DNA or protein	Length (bp)	Implications/ significance/ title of article	Sequences it is related to
HUMPRION D00015	*Homo sapiens* (human)	DNA (mRNA w/ translation)	245	*Science* article about link to Scrapie, Down's Syndrome, Alzheimers	cat, sheep, hamster (LOCI should be noted here)
AF003087	*Felix catus* (cat)	DNA (w/ translation)	795		several variations
S55629	*Bos taurus* (cow)	DNA (w/ translation)	795	*J Inf Dis*: "... prion proteins in bovine spongiform encephalopathy"	
AJ00073	*Avis aries* (sheep)	DNA (w/ translation)	960	*Proc. Natl. Acad. Sci* "2 alleles linked to scrapie..." & other article	

iii) Cut and paste your sequences into a word processing document. Label and place quotations around each sequence.

iv) Analyze your sequences either by computer or by comparing sequences visually. Visual analysis works best with short sequences. Cut and paste long sequences into a sequence analysis site / software. Clustalw, Phylip, and PAUP are 3 popular sequencing programs. They are free (a beta version at least), well documented, and offer support upon request.

Clustalw can be used directly on-line at either of these two sites:
http://www.clustalw.genome.ad.jp/
http://dot.imgen.bcm.tmc.edu:9331/multi-align/Options/clustalw.html

Phylip can be read about and dowloaded from either of these two sites:
http://evolution.genetics.washington.edu/phylip.html
http://www.ibb.waw.pl/docs/PHYLIPdoc/mail.html

PAUP can be read about and downloaded from:
http://paup.csit.fsu.edu/

v) Using the comparison information, students can establish percent similarity and relatedness in terms of years and number of mutations since divergence. They can compare these values with traditionally upheld values of relatedness and divergence between the organisms. The goal is to get a feel for the likelihood of a strain "jumping" from one organism to another through mutation or an organism spontaneously evolving.

8. Assign each student or student group to take one topic and return to class with information about that topic, ready to share in a 2 minute presentation about how the topic is related to this unit.

- naturally-occurring transposons or jumping genes in corn
- transposons or jumping genes in bacteria or humans
- human-induced genetic recombination and cloning
- human-induced genetic recombination and gene therapy
- human-induced genetic recombination and improving plant stocks (genetic engineering)
- human-induced genetic recombination and improving animal stocks (genetic engineering)
- geneticly engineered organisms for cleaning up oil spills
- human-induced genetic recombination such as stem cell research

In summary, why are genetically manipulated food and animals so controversial? How is this related to mutation in strains of disease and their effects on new hosts?